



Patent Application of

Show-Way Yeh

for

**Thin Motor and Pump**

**Field of Invention**

The present invention relates to motors and pumps that are thin.

**Previous Arts**

US patent number	Inventor	Date
6210118	Egawa	4/3/01
6181050	Taussig	1/30/01
6179596	Weisener	1/30/01
5191251	Paratte	3/2/92
5189323	Carr	2/23/93
5187399	Car	2/16/93
5144183	Farrenkopf	9/1/92
5113100	Taghezout	5/12/92



## References to the prior arts

The present invention is to laterally integrate a number of conventional thin rotational or linear motors or electromagnetic devices so that the apparatus can be as thin as few millimeters to be comfortably carried under the user's clothes and can generate enough power to deliver the required medication. As stated in "Mechatronic Micro Devices" by Michael et al in the International Symposium on Micromechatronics and Human Science", 1999, the torque generated by the micro motor can be up to 100  $\mu\text{Nm}$ . It is still too small to drive the reservoir to deliver the required medication. For micro pump using heat, the power supply is usually larger than the flat batteries that can be comfortably carried under the ~~user's~~ clothes. Also, the heat may damage the insulin. For the micro pump with fixed valve, since the pump is not sealed when it is off, the medication may flow backward when the medication is not being pumped. Therefore, it is impractical to be applied to the medication infusion system. The following prior arts are not suitable for this application.

The US patent 6,463,664 to Bieg, etc. presents a planar apparatus for accurately positioning a platform in one or two dimensions without backlash. Since the power of each micro pump is still small, it needs many such devices to generate required power. Also, the rotation axis of the actuators is perpendicular to the surface. It needs transformer to convert such movement to be in parallel with the user's skin to be carried under the user's clothes. It is difficult to be used in the mentioned application. The power supply needs to connect many batteries in the market. This also makes impractical for the mentioned application.

The US patents 6328903 to Vernon, etc. and 6171886 to Ghosh, etc. present variant silicon-based fabrication processes and methods to make microelectromechanical devices that can drive micro actuators. These kinds of devices have too little power to deliver the required medication for the user. In the other words, it needs too many such devices. Again, the power supply is also a problem.

The US patent 6,002,184 to Delson, etc. presents a class of actuators and mechanisms that use repulsive magnetic forces. They are not flat or flexible to be comfortably carried under the user's clothes.

The US patent 5,990,473 to Dickey, etc. presents an apparatus and a method for sensing motion in microelectromechanical systems. It is difficult to be used in the medication infusion system.

The US patent 5,955,817 to Dhuler, etc. presents to heat arched beams to generate kinetic energy. The power supply of this kind of apparatus usually is much higher than the batteries that are comfortably carried under the user's clothes. Therefore, it is impractical to be used for any devices carried under the user's clothes. The heat may damage the insulin. Also, to have enough power, the heat may make the user uncomfortable.

The US patent 5,876,187 to Forster, etc. presents micropump with fixed valve that uses the IC technology and is characterized by the diodicity parameter. It utilizes the ratio of the pressure drop in the reverse-direction fluid flow through the valve to that in the forward-direction. This kind of apparatuses work continuously and the valve is not sealed. When the medicine is not being needed, the apparatus must stop and the medication may flow backward. Therefore, it is impractical to use it for the medication infusion pump.

The US patent 5,644,177 to Guckel, etc. presents an apparatus combining very fine coil and magnetic parts on the IC substrate. This could make the apparatus expensive because the coil and the magnetic parts need to be installed on the apparatus one by one, unlike the IC apparatuses where many apparatuses are manufactured at the same time. Also, the power generated by this apparatus is still too small for medication infusion system like the insulin pump where  $100 \text{ mm}^3$  of insulin may need to be delivered in short time.

The US patent 5,394,131 to Conelius Lungu presents variations of an apparatus that the actuator moves back and forth controlled by the direction of the current supplied to it. To be carried under the user's clothes, this apparatus must be thin, as thin as few millimeters. Then, this apparatus cannot generate enough power to deliver the required medication.

The US patent 4,767,955 to Michael McDaniel presents an apparatus to continuously transfer the oscillation movement of linear motors to rotation movement of gears for the airplanes. The control mechanism is to make the output gears continuously rotate. It is impractical to deliver small amount of medication, as little as  $1 \text{ mm}^3$ , at a time even if the apparatus is made to be small.

The US patent 4,093,880 to Benjiman Teal presents rotation apparatuses using many electro-magnetic devices. This is close to the present invention. However, the difference is that the rotation axis of this invention is perpendicular to the plan of the electro-magnetic devices. This makes the apparatuses of this invention difficult to be used under the user's clothes because the overall apparatus will be too thick. The rotation axis of the present invention is in parallel with the plan of the electro-magnetic devices. So, the apparatuses based on the present invention can be easily and comfortably carried under the user's clothes.